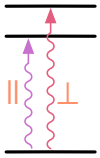
Optically excited NMR μ-detector

Institute of Microstructure Technology,
Karlsruhe Institute of Technology

How much light is absorbed by a molecule? The goal of this project is to extend an existing NMR detector by the function of light management to to make optical excitation of photosensitive molecules more quantitative.

Optically excited NMR



Nuclear magnetic resonance (NMR) is one of the most specific means to obtain molecular information from a sample. Recently, interest has grown in the interaction of light with polymers (e.g. in polymer optoelectronics, organic solar cells, or photolithography), so that the excitation and modification of molecules with and the investigation of light driven molecular reactions are important aspects to study. Conventional NMR detectors do not specifically cater for precise optical manipulation of NMR samples, an aspect that is at the focus of this project.

The project

You will develop a custom optically-instrumented NMR sample container and optical driver system for an existing NMR micro-detector. The task is to achieve an optical system that is able to determine the intensity from a light source (LED, LD) and the amount absorbed by the sample. Light propagation should be realized via wave guides or optical fibers. The goal is to achieve a very high level of control over the flow of photons, from the source (diode, laser) over the propagation via optical fibres, waveguides, and lens systems, to the confinement at the site of the liquid sample. This will also require the design and micro-manufacturing of anti-reflection coatings. It is also of interest to precisely know the quantum efficiency of absorption of the photons by the sample, and to account for for reflection and scattering effects and other loss mechanisms. At the end of the project we expect to have achieved a system that functions within the strong magnetic field (11.74 Tesla) of an NMR superconducting magnet.

During the project you will collaborate with the NMR group of Prof. Thiele at TU Darmstadt, where the system will be tested. It is expected that multiple joint project meetings will take place at both locations.

Type of work

The project is strongly experimental, but optical design and calculations are also required.

- Design and simulation.
- Manufacturing (mechanical/optical workshop and clean room).
- Optical testing and NMR characterisation.

Requirements

- Strong interest in applied optical microsystems technology.
- Attendance of lectures in optics and photonics.
- Independence, reliability.

Contact

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